

## **Remarks**

The various parts of the Office Action (and other matters, if any) are discussed below under appropriate headings.

### ***Restriction***

The withdrawn claims have been cancelled.

### ***Declaration***

The Examiner's indication that the previously submitted declaration completes the record is noted with appreciation.

### ***Information Disclosure Statement***

On one of the PTO-1449 forms returned with the Office Action, the Examiner did not acknowledge consideration of one of the documents because a copy was not received although it is believed a copy was submitted with the Information Disclosure Statement that listed the same. Another copy of the Set et al. article entitled "High Bitrate Operation of a Novel Optical Phase Conjugator Using Inline Fibre DFB Lasers" was faxed to the Office on November 13, 2002. An acknowledgment of consideration of the Set et al. article is requested.

### ***Priority Claim***

The Examiner's clarification that the UK priority document has not been received is noted with appreciation. A certified copy of the UK priority application will be submitted in due course.

### ***Art Rejections***

The rejection of claims 1-11 is based primarily on the article of Storoy et al. From the Examiner's remarks on page 4 of the Office Action, the Examiner appears to be of the view that claim 1 is anticipated by the "intermediate article" of Storoy et al.

Claim 1 recites a method of fabricating an optical fiber laser, the method comprising the step of exposing an optical fiber to a transverse writing light beam to form a grating structure in a section of the optical fiber. The writing light beam is polarized in a direction not parallel to the axis of the section of the optical fiber so that the induced grating structure has a different grating strength for two orthogonal

polarization modes of the optical fiber, and the grating structure comprises a discrete phase shift which is substantially identical for the two orthogonal polarization modes.

Storey et al. describe (in the "*Experiments*" paragraph) writing a grating consisting of two parts with an arbitrary phase shift between them. This is presumably the intermediate article referred to by the Examiner. It is stated by Storoy et al. that the arbitrary "phase shift is defined by the optical path distance between the two parts." Optical path distance is defined as  $nL$ , where  $n$  is the refractive index of the material and  $L$  is the physical distance, in this case any separation between the gratings.  $L$  is equal for the two orthogonal polarization modes. However,  $n$  must be different for the two modes, because of intrinsic birefringence of the fiber as described in the "*Grating birefringence*" paragraph, and possibly also any birefringence induced in the fiber portion in question from exposure to the s-polarized light during writing of the grating parts. Therefore,  $nL$  is different for the two polarization modes, which means that the phase shift must also be different. Storoy therefore does not teach a grating structure comprising a discrete phase shift which is substantially identical for the two modes, as set forth in claim 1. Therefore, claim 1 is novel.

The purpose of Storoy et al.'s phase shift is that it is tuned, in a post-processing step, so that the phase shift difference between the two polarization modes is sufficient to give a large enough difference in threshold gain for the two modes so that only one mode can lase, and single mode operation is achieved. The presence of a difference in phase shift for the two modes is therefore key to the operation of Storoy et al.'s device. Consequently, there is no incentive to modify the first step of the teaching of Storoy et al. to achieve a substantially identical phase shift, as set forth in claim 1. Therefore, claim 1 is nonobvious.

Further, the present invention recognizes that single mode fiber laser operation can be achieved by providing a grating structure which has a difference in grating strength between the two orthogonal polarization modes of the fiber, where the grating is written using non-parallel polarized writing light so as to have the features of claim 1. Strong polarization mode discrimination is provided by such a structure, so that robust single mode operation can be achieved (page 2, lines 7-14). Thus, it is possible to produce a single mode fiber laser using just one fabrication step. This is in complete contrast to the teachings of Storoy et al., which instead rely for single mode operation on providing a grating structure which includes a phase shift that is different for the two polarization modes. A second processing step is required to tune the phase shift difference after initial writing of the grating, so that the fabrication is significantly more complex than in the present invention. Storoy et al., although using s-polarized light to write their gratings, make no use of the birefringence of the grating thereby produced,

and do not indicate that any single mode laser operation is expected from the initially written grating structure before tuning of the phase shift difference. Therefore, the first step of Storoy et al. cannot be considered to be "A method of fabricating an optical fiber laser" to which claim 1 is directed. The present invention is therefore in no way taught, suggested or alluded to by Storoy et al.

### ***New Claims***

New claims 27-37 are identical to claims 1-11, respectively, except that in claim 27, "comprising" is replaced by "consisting". The Examiner notes on page 4 of the office action that "the use of 'comprising' language opens the interpretation of the claims to additional steps." Claim 27 is limited to a one-step method for fabricating an optical fiber laser, and that further steps are not included. Clearly, new claim 27 is allowable over Storoy et al. In addition, entry of new claims 27-37 is requested, inasmuch as these claims are not believed to present an issue not already considered by the Examiner and their introduction was prompted by the Examiner's comment.

### ***Further Comments***

The Examiner notes that the grating fabrication techniques of Storoy et al. differ from those described in the present application. He describes Storoy et al. as using a "two beam recording method," by which he presumably means the use of two-beam interference to generate a fringe pattern to write the grating. This is compared to the single beam phase mask technique shown in figure 3a of the application. The Examiner then invites the Applicant to supply evidence showing that these two techniques will produce the relevant different and identical phase shifts of Storoy et al. and the present invention, after expressing a view that both techniques will give an equal phase shift. However, it is pointed out that any difference in the writing techniques of Storoy et al. and the present invention are incidental and not relevant for the purposes of showing patentability. What is of importance is that the grating structure is written using non-parallel polarized light and attains the features of claim 1. This is clear from the description, which indicates that writing techniques other than that described could be used (page 4, lines 27-29). Therefore, no evidence on this point is considered necessary.


Erdogan et al. does not overcome the above discussed deficiencies of Storoy et al. In fact, Erdogan et al. is cumulative, in that the teaching that s-polarized light produces a greater birefringence than p-polarized light is summarized by Storoy et al. ("*Grating birefringence*" paragraph).

**Conclusion**

This application is believed to be in condition for allowance and an early action to that effect is earnestly solicited.

Respectfully submitted,

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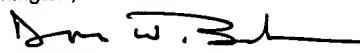
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